

TURFGRASS TRENDS

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AGRONOMY

Thermal Tolerance: The Role of Heat Shock Proteins

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Plants live within a narrow temperature range of 32 to 122 F (0 to 50 C) with metabolic processes restricted to 50 to 104 F (10 to 40 C). Optimum shoot growth for cool season turfgrasses occurs between 60 to 75 F (10 to 24 C). When temperatures are outside the optimum range, turfgrass growth is hindered or reduced. High temperatures result in morphological changes including reduced shoot and root growth, decreased stand density and leaf width.

Physiological changes for cool season turfgrasses include reduction in photosynthesis, and an increase in respiration and photorespiration, resulting in decreased carbohydrate levels. As temperatures approach lethal levels, degradation of proteins, and membrane disruption occur resulting in overall shutdown of cellular functions. As cellular functions are disrupted or destroyed, cell death occurs leading to plant death.

The killing or lethal temperature for cool season turfgrasses is dependent on the temperature and exposure time. Upper limit for cool season turfgrasses is considered to range from 113 to 131 F (45 to 55 C), with killing temperatures for Kentucky bluegrass, perennial ryegrass, and annual bluegrass occurring around 117 F (47 C).

Indirect temperature stress where temperatures are above the optimum but below lethal, are common on cool season turfgrasses. Decrease in shoot and root growth along with a reduction in stand density are common symptoms observed by golf course superintendents and turfgrass managers during summer stress times.

On the other hand, direct high temperature kill of turfgrass plants from a historical perspective is considered a rare event. However, as we expand the use of cool season turfgrasses, especially creeping bentgrass, into climactic regions that are considerably less adaptable due to higher temperatures, and as management practices become more "on the edge" (low height of cut, wear, etc.), the probability of direct temperature kill increases.

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Heat shock response

We have studied how turfgrass plants respond to thermal stress. Although not a common event, turfgrasses — especially cool season turfgrasses, in the transition zone can reach canopy temperatures considered lethal, yet the plants survive without any apparent damage.

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